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(54) **SEGMENTED ARMATURE MOTOR HAVING A SEGMENTED COIL FRAME HAVING COIL WINDINGS ON THE OUTER SURFACE**

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H02K 3/18	(2006.01)
H02K 3/47	(2006.01)

(Continued)

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USPC 310/86, 89, 164, 179, 180, 208, 310/216.002, 216.004, 216.007

See application file for complete search history.

(56) **References Cited**

U.S. PATENT DOCUMENTS

3,191,081	A *	6/1965	Faulhaber	H02K 23/56 310/154.04
3,209,187	A *	9/1965	Angele	H02K 3/26 310/154.23
3,360,668	A *	12/1967	Faulhaber	H02K 3/04 29/596
4,103,196	A *	7/1978	Saito	H02K 3/04 310/154.04

(Continued)

FOREIGN PATENT DOCUMENTS

CN	1324510 A	11/2011
JP	09-507640	7/1997

(Continued)

OTHER PUBLICATIONS

International Search Report dated Mar. 14, 2012, corresponding to PCT/KR2011/005483.

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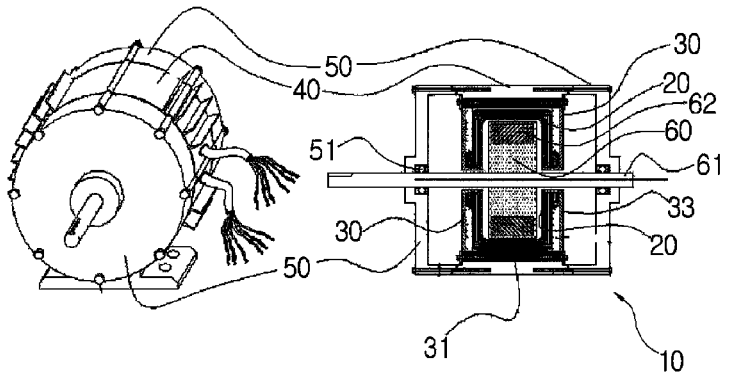
(57) **ABSTRACT**

Provided is a segmented armature motor, which includes a plurality of armature coils which enclose a rotor having a rotary shaft, an armature which houses the armature coil and which is coupled in a segmented form, a motor frame which is coupled to the armature so as to enclose the armature, and motor covers coupled to the front and rear faces of the motor frame. The segmented armature motor is formed so that the armature coils completely enclose a pole portion of the rotor and are formed into a horseshoe shape or U shape, thereby minimizing magnetic losses of the armature and of the rotor.

10 Claims, 10 Drawing Sheets



(51) **Int. Cl.**
H02K 3/52 (2006.01)
H02K 21/12 (2006.01)

(56) **References Cited**

U.S. PATENT DOCUMENTS

4,110,901	A *	9/1978	Nakamura	H02K 3/04 29/598
4,556,811	A *	12/1985	Hendricks	H02K 3/04 310/208
4,968,911	A *	11/1990	Denk	310/216.007
5,767,596	A *	6/1998	Stark et al.	310/89
5,798,591	A *	8/1998	Lillington et al.	310/164
6,351,052	B1 *	2/2002	Kim	310/179
8,084,909	B2 *	12/2011	Goodzeit	H02K 55/00 310/112
2004/0119356	A1 *	6/2004	Anwander	H02K 1/2773 310/156.55
2004/0164638	A1 *	8/2004	Asaba	310/208
2008/0143200	A1 *	6/2008	Kalsi	H02K 1/12 310/58
2008/0278020	A1 *	11/2008	Ley	H02K 1/148 310/156.36

FOREIGN PATENT DOCUMENTS

JP	H09-507640 A	7/1997
JP	2002-529035 A	9/2002
JP	2003-264947	9/2003
JP	2008-199691	8/2008
KR	20-1999-0023364	7/1999
KR	10-2009-0003577	1/2009

* cited by examiner

Fig. 1

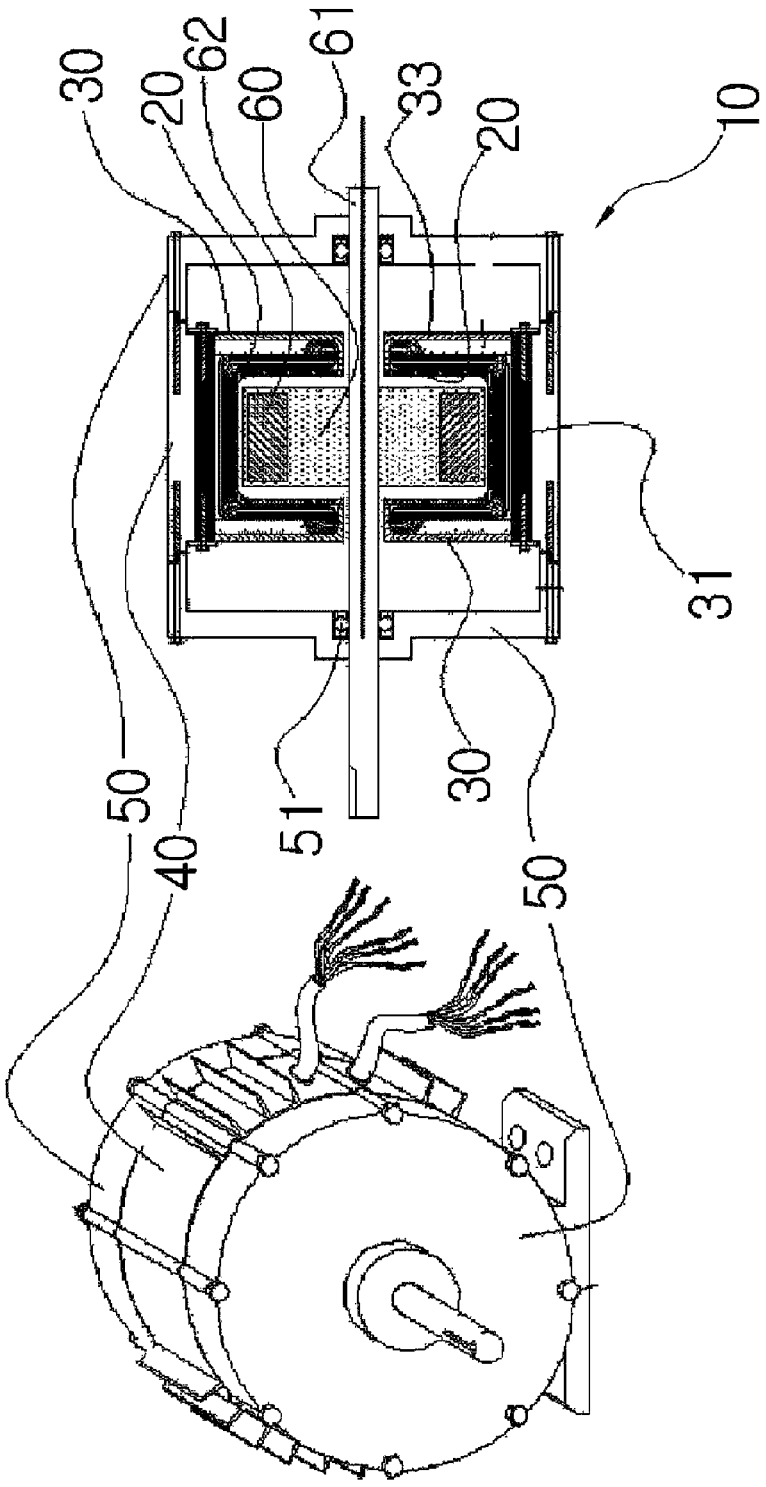


Fig. 2

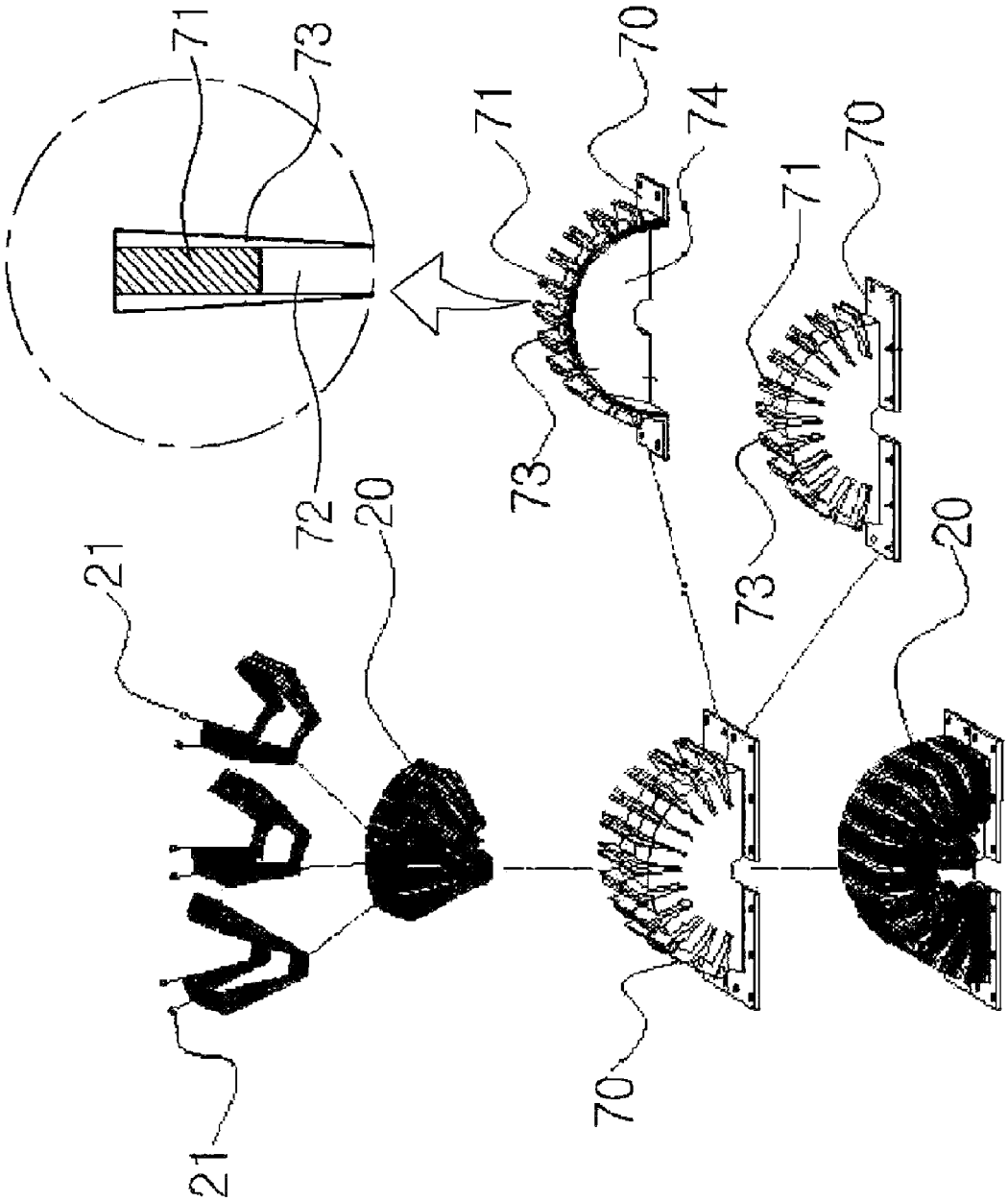


Fig. 3

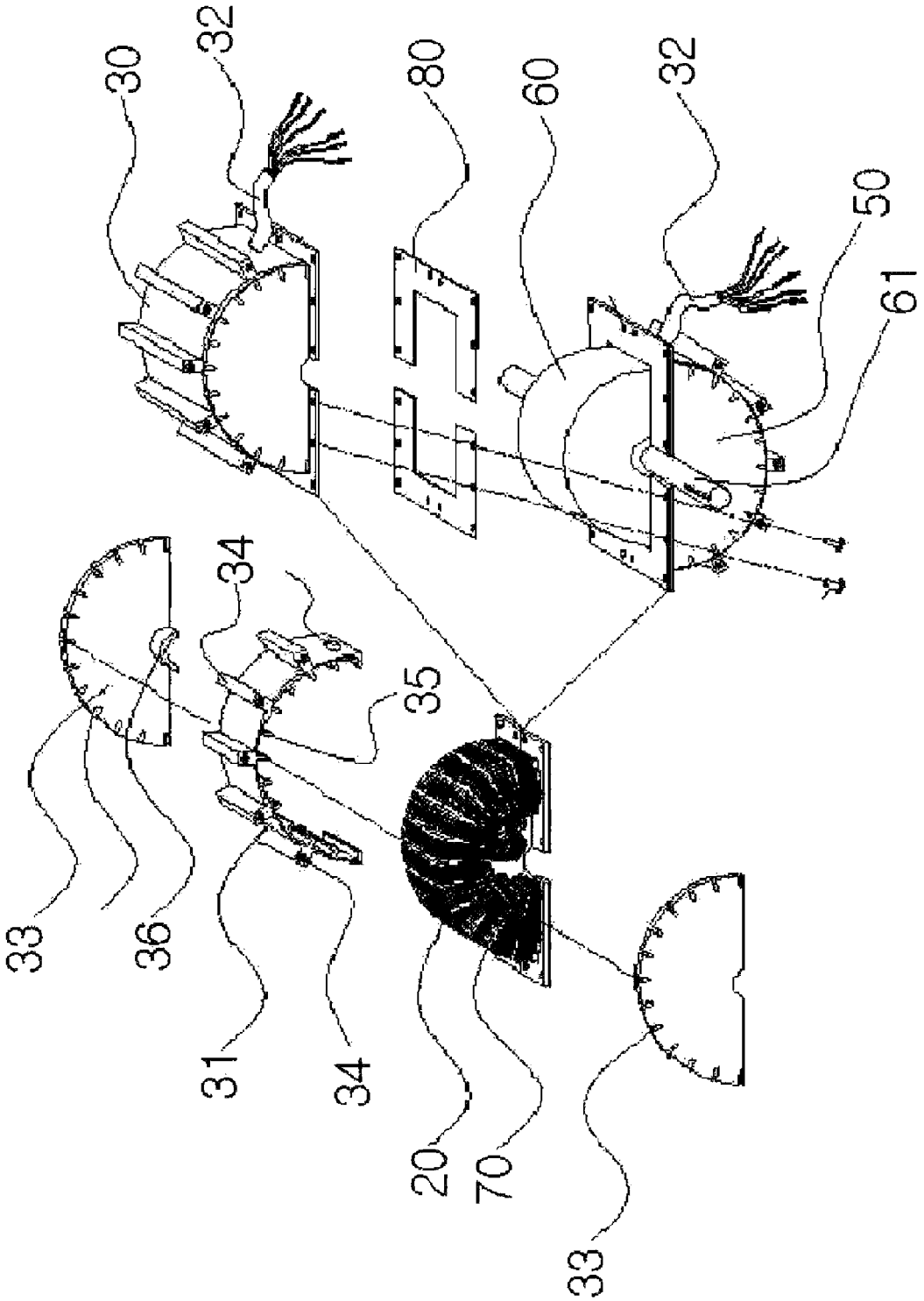


Fig. 4

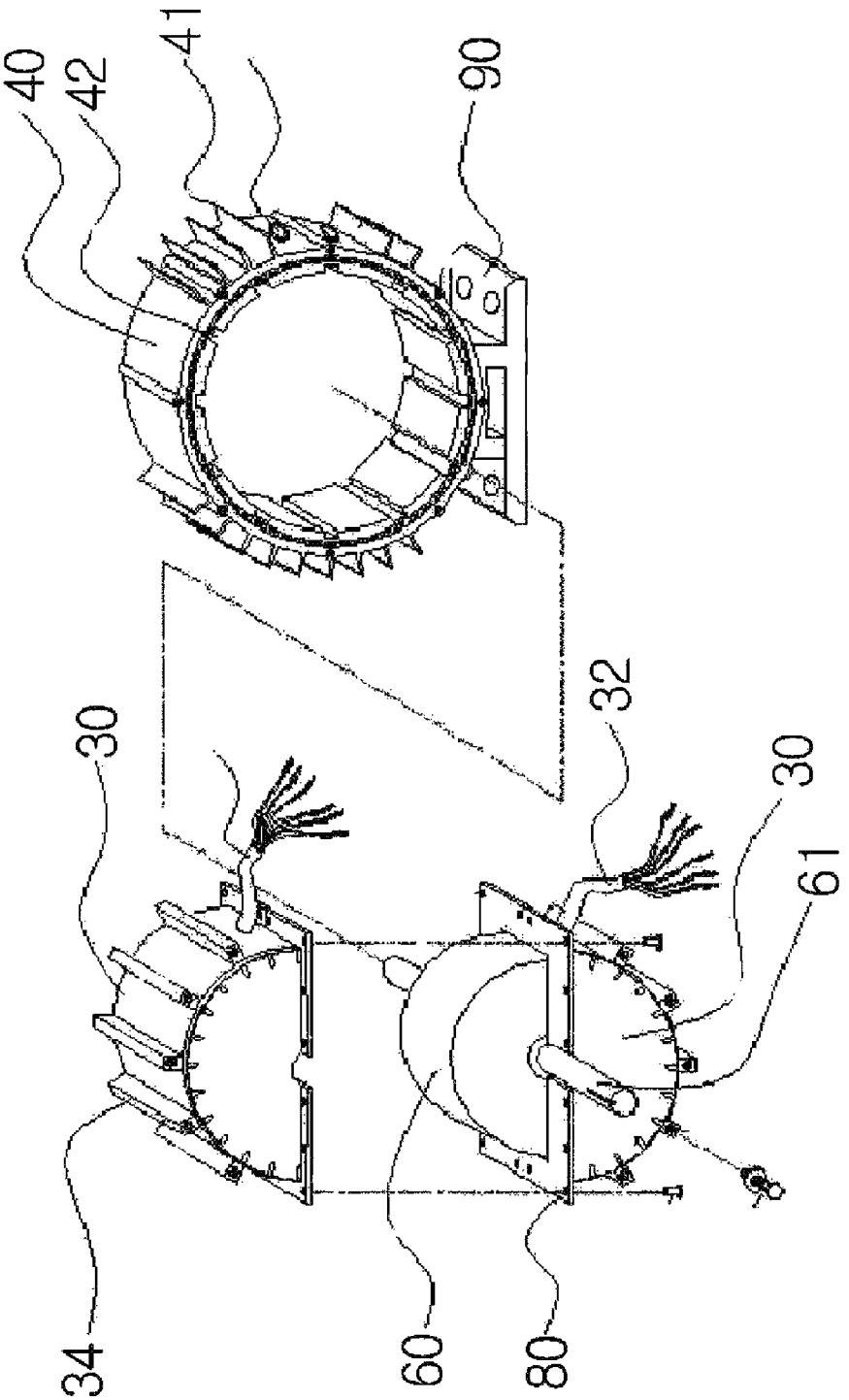


Fig. 5

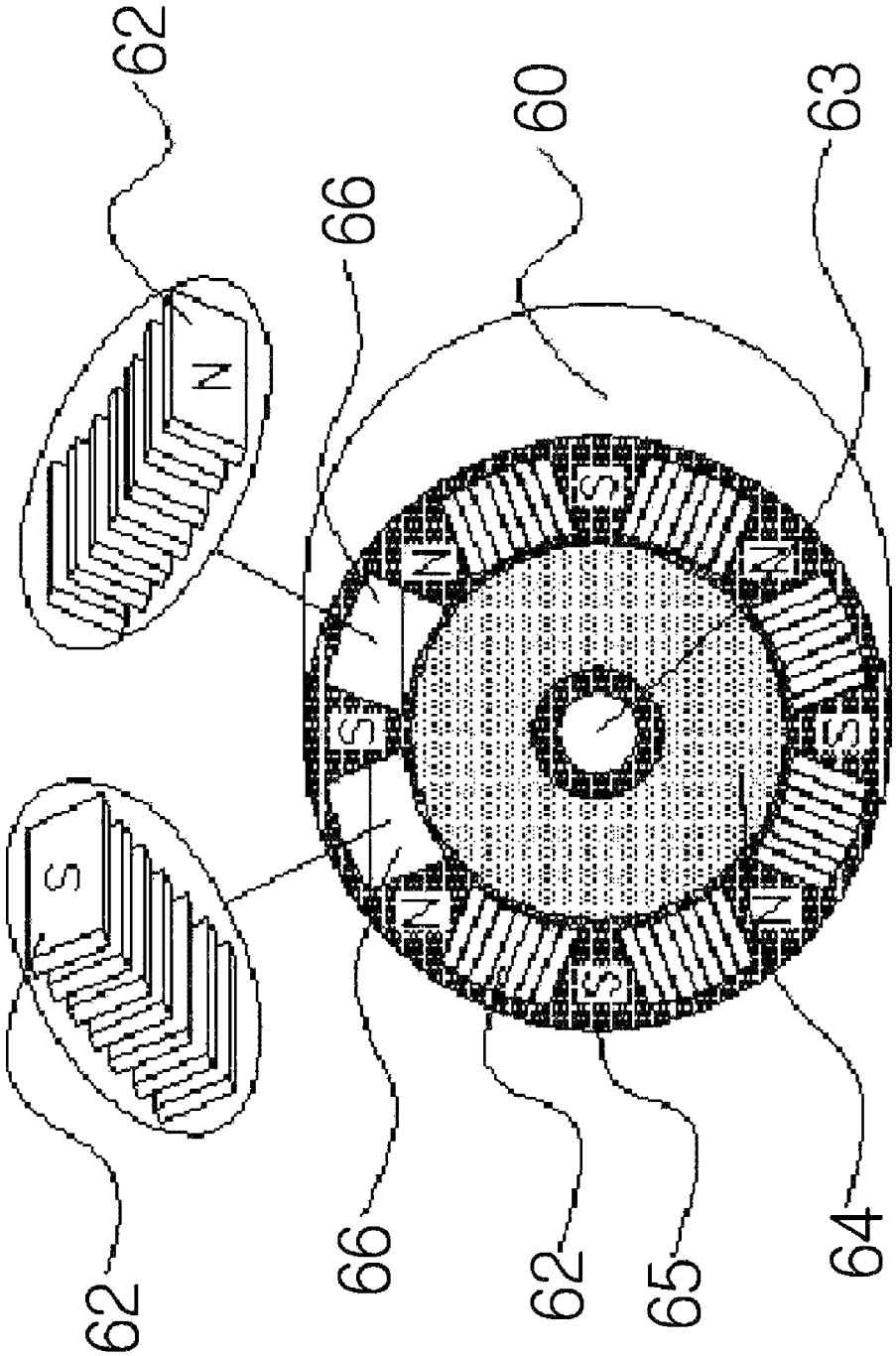


Fig. 6

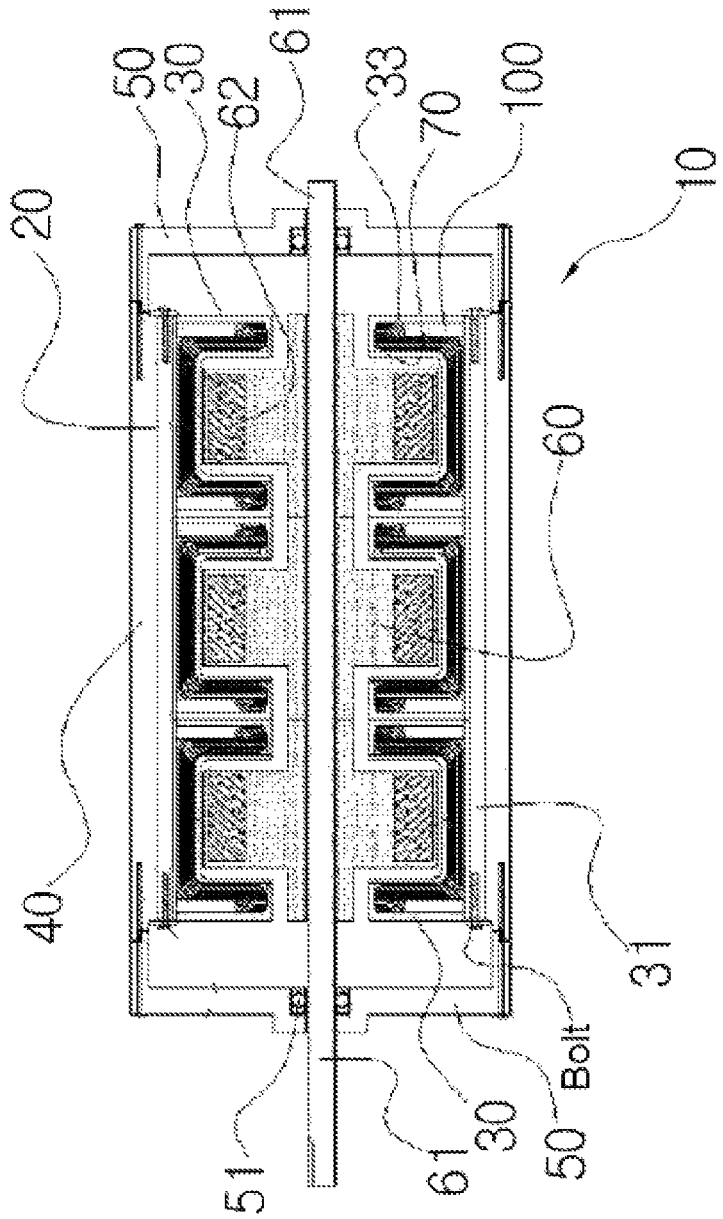


Fig. 7

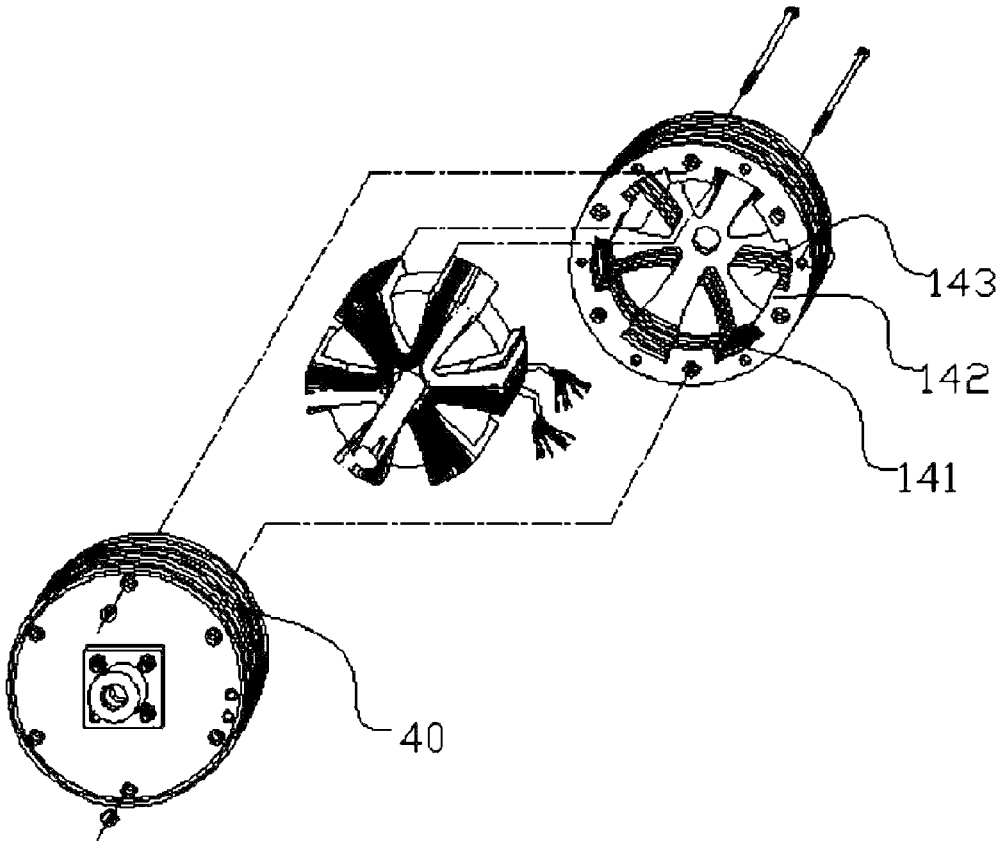


Fig. 8

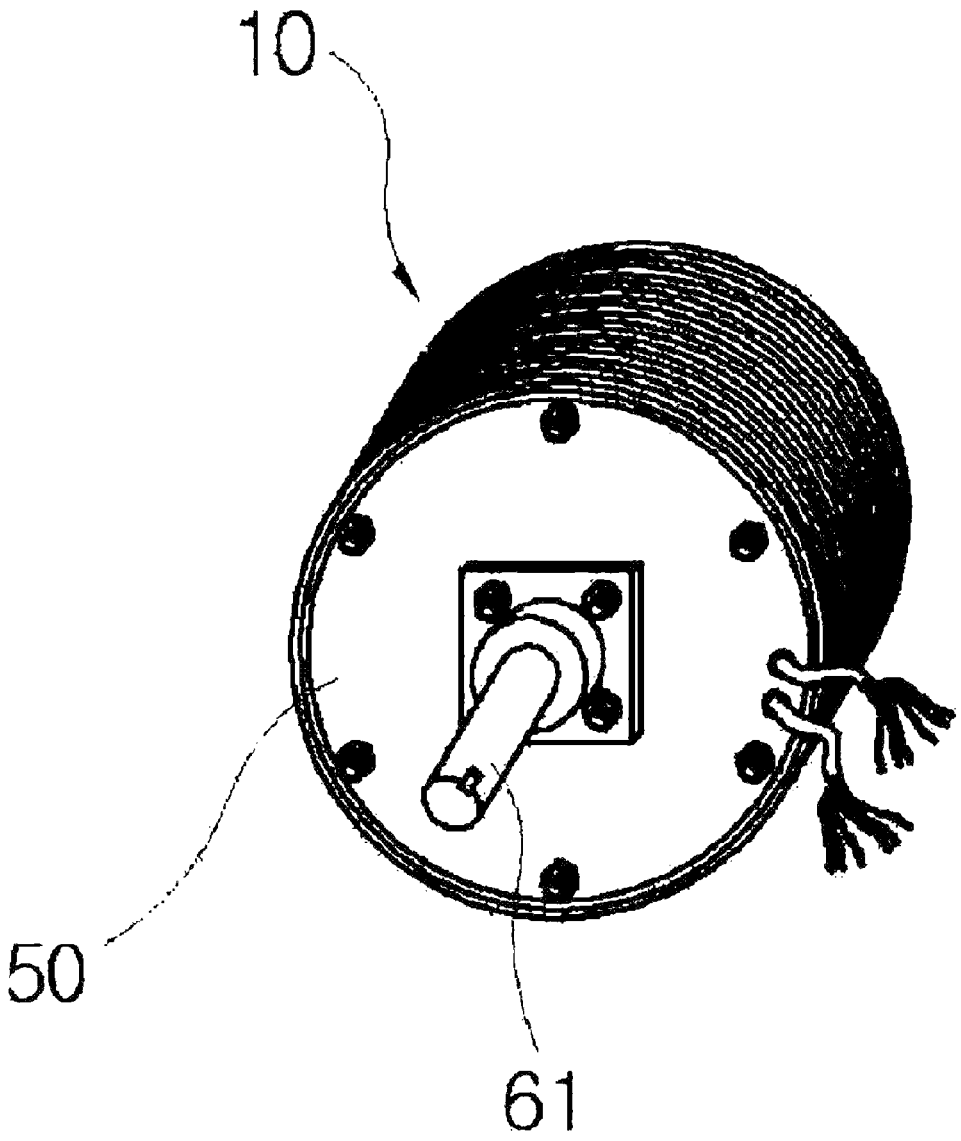


Fig. 9

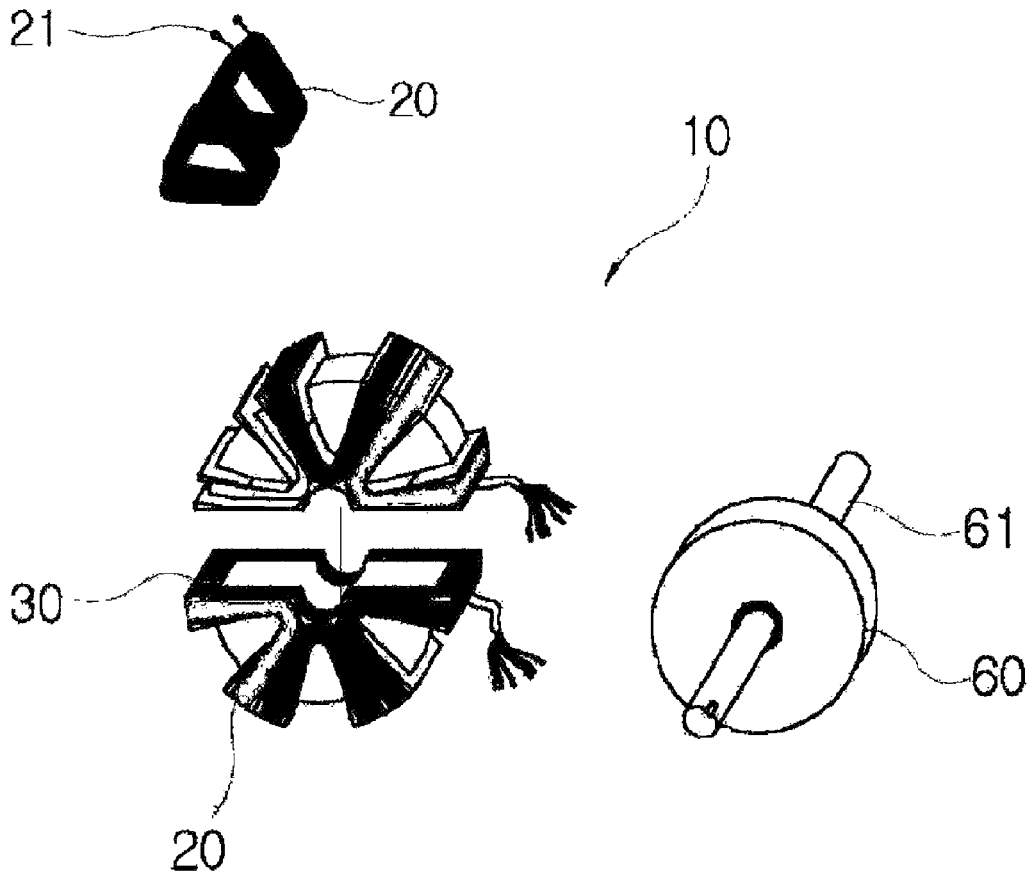
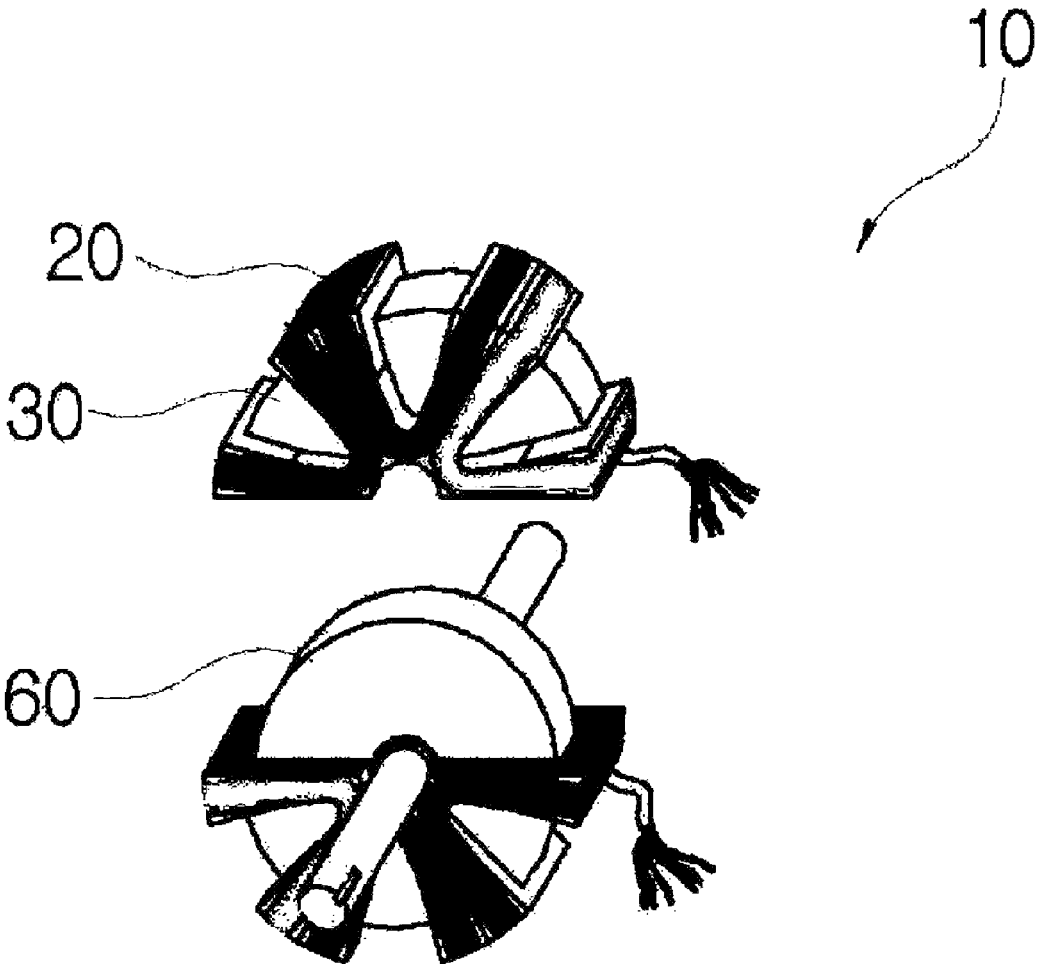


Fig. 10



SEGMENTED ARMATURE MOTOR HAVING A SEGMENTED COIL FRAME HAVING COIL WINDINGS ON THE OUTER SURFACE

TECHNICAL FIELD

The present invention relates to a segmented armature motor and, more particularly, to a segmented armature motor whose armature coil and rotor are improved in configuration so as to be able to increase efficiency thereof.

BACKGROUND ART

In general, a synchronous motor refers to a constant speed motor (a kind of an alternating current motor) that rotates at a constant frequency at a constant speed (synchronous speed) regardless of a load. This synchronous motor is typically configured with 3-phase windings arranged to form a rotating magnetic field on a stator and magnets (permanent magnets or electromagnets) embedded to form magnetic poles (N and S poles) in a rotor having a laminated structure of core members (iron cores).

The synchronous motor as described above is generally driven by the rotating magnetic field generated between the stator and the rotor. The synchronous motor having this driving method typically has a characteristic of rotating at a speed that is proportional to a frequency of supply voltage applied to the 3-phase windings and is inversely proportional to the number of magnetic poles of the rotor, i.e., at a speed that is synchronized with a frequency of input voltage.

However, since electromagnetic force acts on only one corresponding face, a conventional motor or generator requires the iron core that is a passage of strong electromagnetic force, and is reduced in efficiency due to a loss of the lines of electromagnetic force applied to the iron core.

DISCLOSURE

Technical Problem

Accordingly, the present invention has been made keeping in mind the above problems occurring in the related art, and an object of the present invention is to provide a segmented armature motor that is formed so that armature coils completely enclose a pole portion of the rotor and are formed into a horseshoe shape or U shape, thereby minimizing magnetic losses of the armature and of the rotor.

Technical Solution

According to an aspect of the present invention, there is provided a segmented armature motor, which includes: a plurality of armature coils enclosing a rotor having a rotary shaft; an armature housing the armature coils and coupled in a segmented form; a motor frame coupled with the armature so as to enclose the armature; and motor covers coupled to front and rear faces of the motor frame.

Here, each armature coil may be formed in a hollow shape, be bent from one or opposite ends of an intermediate portion thereof, and include armature coil terminals on one side thereof.

Further, the segmented armature motor may further include a coil frame that is coupled in a segmented form between the armature coils and the rotor and that includes support slots formed at intervals and coil frame support walls formed slantingly.

Further, the armature may be made up of an armature frame having an armature cable and armature covers coupled to front and rear faces of the armature frame, and a dielectric sheet may be mounted between the coil frame and the armature frame.

In addition, permanent magnets constituting the rotor may be configured so that N and S poles thereof are disposed in a rotating direction of the rotor, and so that the neighboring ones thereof are disposed so as to have repulsive poles.

Advantageous Effects

According to the present invention, the segmented armature motor is formed so that the armature coils completely enclose a pole portion of the rotor and are formed into a horseshoe shape or U shape, thereby making it possible to minimize magnetic losses of the armature and of the rotor.

Further, the armature coils enclose a great part of field poles. In the case of a motor, the magnetic flux generated from the armature is concentrated on the center and thus increases efficiency of rotation of the field poles. In the case of a generator, the magnetic flux generated from the armature is linked with the armature coils with no loss of the magnetic flux generated from the field poles and thus increases efficiency of the generator.

DESCRIPTION OF DRAWINGS

FIG. **1** is a view showing a segmented armature motor according to an embodiment of the present invention.

FIGS. **2** to **4** are perspective views showing a process of assembling the segmented armature motor according to the embodiment of the present invention.

FIG. **5** is a cross-sectional view showing a rotor constituting the segmented armature motor according to the embodiment of the present invention.

FIG. **6** is a cross-sectional view showing a segmented armature motor according to another embodiment of the present invention.

FIGS. **7** and **8** are disassembled and assembled perspective views showing a segmented armature motor according to yet another embodiment of the present invention.

FIGS. **9** and **10** are perspective views showing a process of assembling the segmented armature motor according to the other embodiment of the present invention.

MODE FOR INVENTION

Hereinafter, embodiments of the present invention will be described with reference to the accompanying drawings. FIG. **1** is a view showing a segmented armature motor according to an embodiment of the present invention. FIGS. **2** to **4** are perspective views showing a process of assembling the segmented armature motor according to the embodiment of the present invention. FIG. **5** is a cross-sectional view showing a rotor constituting the segmented armature motor according to the embodiment of the present invention.

A segmented armature motor **10** according to an embodiment of the present invention includes a plurality of armature coils **20** enclosing a rotor **60** having a rotary shaft **61**, an armature **30** housing the armature coils **20** and coupled in a segmented form, a motor frame **40** coupled with the armature **30** so as to enclose the armature **30**, motor covers **50** coupled to front and rear faces of the motor frame **40**, and a coil frame **70** mounted between the armature coils **20** and the rotor **60**.

Each armature coil **20** is formed in a hollow shape, is bent from one or opposite ends of an intermediate portion thereof, and is provided with armature coil terminals **21** on one side thereof.

In detail, each armature coil **20** is formed in a hollow shape such as a horseshoe shape or a U shape, and has armature coil terminals **21** mounted on one side thereof.

In greater detail, each armature coil **20** is shaped so as to enclose the coil frame **70** to be described below, and is formed in a double horseshoe or U shape by bending a circular or quadrangular coil on opposite sides thereof at constant intervals. Each armature coil is installed so as to enclose an outer circumference and opposite sides of the rotor in three directions. Typically, the armature coils **20** are installed in units of a multiple of 3, and are distinguished into front and rear portions in an order in which each is in contact with the rotor **60**.

For example, when two magnetic poles of the rotor are N and S poles, three armature coils are installed in such a manner that the front portions thereof are located in turn at positions where a region of the N pole is divided into three equal parts, and that the rear portions thereof are also located in turn at positions where a region of the S pole is divided into three equal parts. This installing method is repeated.

The armature coils **20** are coupled as unit coils, and the armature coil terminals **21** are formed on each armature coil, and are connected based on an armature circuit configuration.

Here, when a set of the overall armature coils **20** are configured of an armature coil circuit corresponding to two field poles (N and S), this becomes a two-pole motor. When the set of the overall armature coils **20** are configured of an armature coil circuit corresponding to four field poles (N, S, N and S), this becomes a four-pole motor.

Moreover, the coil frame **70** mounted between the armature coils **20** and the rotor **60** is segmented, and is provided with an internal space **74** so as to house the rotor **60**.

In detail, the coil frame **70** is formed in two so as to be easily assembled. Flanges of the segmented coil frames are formed so as to be easily coupled and positioned in such a way that one thereof is formed with coupling holes and that the other is formed with coupling protrusions.

An outer surface of the coil frame **70** is provided with coil frame partitions **71**, each of which has support slots **72** at intervals and a coil frame support wall **73** slantingly formed on one or opposite sides thereof.

Thus, each armature coil **20** is fixed using the support slots **72** and the support wall(s) **73** of each coil frame partition **71**.

The armature **30**, which houses the armature coils **20** and is coupled in a segmented form, is made up of an armature frame **31** having an armature cable **32** and armature covers **33** coupled to front and rear faces of the armature frame **31**.

An outer surface of the armature frame **31** is provided with armature frame fixtures **34** protruding at intervals.

In detail, the armature frame **31** houses the armature coils **20** and the coil frame **70**, which are coupled to each other. The armature frame **31** is configured so that frame supports **35** protruding from an inner surface thereof are fixedly inserted into the coil frame partitions **71** constituting the coil frame **70**. Then, the armature covers **33** are coupled to the armature frame **31**. The other armature frame **31** is fixedly coupled in the process above.

Here, the armature covers **33** are each provided with an extension **36** so as to be able to prevent the armature coils **20** from being exposed. A dielectric sheet **80** is mounted between the coil frame **70** and the armature frame **31**.

The motor frame **40** enclosing the armature **30** is provided with motor frame cooling fins **41** protruding from an outer surface thereof at intervals for cooling the armatures, and motor frame insertion grooves **42** formed in an inner surface thereof at intervals.

That is, the motor frame **40** is configured so that the armature **30** of the rotor **60** is inserted into the motor frame insertion grooves **42** formed in the inner surface thereof. Here, the motor frame **40** may be selectively provided with a pedestal **90** on the outer surface thereof so as to be able to stably support the motor frame **40**.

In the embodiment, an example in which the motor frame **40** is formed in a cylindrical shape will be described.

Motor covers **50** coupled to front and rear faces of the motor frame **40** are formed in a shape corresponding to that of the motor frame **40**. Bearings **51** are mounted on portions of the motor covers **50** through which the rotary shaft **61** of the rotor **60** passes. The motor covers **50** are bolted to the motor frame **40**.

That is, the motor covers **50** are coupled to the motor frame **40** to which the armature coils **20**, the coil frame **70**, the armature **30**, and the rotor **60** are coupled.

The rotor **60** mounted in the coil frame **70** is formed of a non-magnetic conductor, and is provided with a rotor hole **63** for the rotary shaft **61** in the inner center thereof. An inner cylinder **64** of the rotor can be reduced in density by a process, and an outer cylinder **65** of the rotor is provided with magnet holes **66** into which permanent magnets **62** can be inserted.

In the embodiment, the permanent magnets **62** are configured so that N and S poles thereof are disposed in a rotating direction of the rotor, and so that the neighboring ones thereof are disposed so as to have repulsive poles, i.e. the same poles.

Here, as each permanent magnet **62**, a laminated permanent magnet of flat magnets or a monolithic permanent magnet is used.

Next, FIG. **6** shows a segmented armature motor **10** according to another embodiment of the present invention. The segmented armature motor **10** is configured so that permanent magnets **62** are fixed so as to be able to rotate along with each rotor **60** to which a rotary shaft **61** is fixed, so that an armature frame **31** is fitted to a coil frame **70** with armature coils **20** installed and is covered with armature covers **33**, and so that a filler **100** is inserted into a space between the armature frame and each armature cover and fixes the armature coils **20**.

In a state in which segmented armatures **30** are engaged with each other, a motor frame **40** is fixed using fixing bolts. The rotary shaft **61** is coupled inside the armature **30**, and the rotor **60** equipped with the permanent magnets **62** is rotatably installed.

Next, motor covers **50** having bearings **51** are fixed to the motor frame **40** using assembling bolts. It is shown that a plurality of motor drivers are installed in one motor frame **40**.

Next, FIGS. **7** to **10** show a segmented armature motor according to yet another embodiment of the present invention. The segmented armature motor **10** includes a plurality of armature coils **20**, an armature **30** housing the armature coils **20** and coupled in a segmented form, a motor frame **40** coupled with the armature **30** so as to enclose the armature **30**, and motor covers **50** coupled to front and rear faces of the motor frame **40**.

In the segmented armature motor **10**, the armature **30** is integrally formed with a coil frame **70**.

Each armature coil **20** is configured to be bent in a horseshoe or U shape at predetermined intervals and to enclose the rotor **60**, and is installed on the coil frame **70** so as to be the segmented armatures **30**.

The rotor **60** to which the rotary shaft **61** is coupled is inserted inside the segmented coil frames **70**. The coil frames coupled with the rotor **60** are coupled with the motor frame **40**. The motor frame **40** is segmented into two parts which are inserted at opposite sides of the rotary shaft **61**. Each part of the motor frame **40** is configured to have coil recesses **141** into which the armature coils **20** are inserted so as to be in close contact according to a shape of each armature **30**, first protrusions **142** fitted into circumferential spaces of the armature coils **20**, and second protrusions **143** inserted into lateral spaces of the armature coils **20**.

Further, the coil recesses **141**, the first protrusions **142**, and the second protrusions **143** of the motor frame **40** may be formed by laminating a plurality of iron core sheets.

A process of assembling the segmented armature motor configured as described above will be described.

First, the coil frame **70** is formed in two so as to have the internal space **74** formed therein and the coil frame partitions **71** formed on the outer surface thereof. Each of the coil frame partitions **71** has the support slots **72** formed at intervals and the coil frame support wall **73** slantingly formed on one or opposite sides thereof.

The armature coils **20** are mounted between the coil frame partitions **71**. Each armature coil **20** is formed in a hollow shape such as a horseshoe or U shape, and is mounted with the armature coil terminals **21** on one side thereof.

Next, the rotor **60**, which is formed of a non-magnetic conductor and has the rotary shaft **61** mounted in the inner center thereof and the magnet holes **66** formed in the outer cylinder **65** thereof so that the permanent magnets **62** can be inserted, is mounted in the internal space **74** of one coil frame **70**, and then the coil frames **70** are coupled.

The armature **30** is formed so as to have the armature frame **31** equipped with the armature cable **32**, the armature covers **33** coupled to the front and rear faces of the armature frame **31**, the armature frame fixtures **34** protruding from the outer surface of the armature frame **31** at intervals, and the frame supports **35** protruding from the inner surface of the armature frame **31** at intervals, and then an assembly of the armature coil **20**, the rotor **60**, and the coil frame **70** is mounted in the armature **30**.

In detail, the armature frame **31** houses the armature coils **20** and the coil frame **70**, which are coupled to each other. The armature frame **31** is configured so that the frame supports **35** protruding from the inner surface thereof are fixedly inserted into the coil frame partitions **71** constituting the coil frame **70**. Then, the armature covers **33** are coupled to the armature frame **31**. The other armature frame **31** is fixedly coupled in the process above.

Next, the armature **30** is inserted into the motor frame **40** that has the motor frame cooling fins **41** protruding from the outer surface thereof at intervals for cooling the armatures and the motor frame insertion grooves **42** formed in the inner surface thereof at intervals. Then, the motor covers **50** are mounted in the front and rear of the motor frame **40**. Thereby, the process of assembling the segmented armature motor **10** is completed.

Here, the assembly sequence of the segmented armature motor **10** may be different from the aforementioned sequence.

While the segmented armature motor of the present invention has been described on the basis of a specific shape and direction with reference to the attached drawings, it will be appreciated by those skilled in the art that various modifications, additions, and substitutions are possible and should be interpreted to fall into the scope and spirit of the present invention as disclosed in the accompanying claims.

The invention claimed is:

1. A segmented armature motor comprising: an armature having a plurality of frame supports formed protruding inward directions and frame fixtures formed protruding outward directions at intervals: a coil frame having a plurality of paired-coil frame support walls and coil frame partitions formed at intervals, the coil frame partitions being formed between inside of each paired-coil frame support walls, and the coil frame partitions being gradually widened in a radial outward direction based on the paired-coil frame support walls, each which are slantingly formed in a radial outward direction based on the coil frame, the coil frame comprising a first coil frame and a second coil frame, each of the first and second coil frame being formed as symmetrical hemisphere; a rotor inserted into the coil frame and having a rotary shaft; a paired dielectric sheet is mounted between the first and second coil frame; and a plurality of armature coils formed at each of the coil frame partitions of the coil frame, wherein each of the plurality of paired-coil frame support walls is inserted between the plurality of frame supports, wherein each of the plurality of armature coils is formed in such a way that an interval thereof is as gradually widened in a radial outward direction on each of the coil frame partitions of the coil frame.

2. The segmented armature motor according to claim **1**, wherein the rotor includes permanent magnets whose N and S poles are disposed in a rotating direction of the rotor.

3. The segmented armature motor according to claim **2**, wherein the permanent magnets are configured so that the neighboring ones thereof are disposed so as to have repulsive poles.

4. The segmented armature motor according to claim **1**, wherein the coil frame is segmented into upper and lower coil frames having a semi-circular cross section, and the upper and lower coil frames are assembled so as to face each other.

5. The segmented armature motor according to claim **4**, wherein an armature is made up of the armature coils that are installed on an outer circumference of each of the upper and lower coil frames, and of the rotor installed in the upper and lower coil frames.

6. The segmented armature motor according to claim **5**, further comprising a motor frame enclosing the armature.

7. The segmented armature motor according to claim **6**, wherein the motor frame is formed in a shape of a cylinder segmented into two left-hand and right-hand parts that are assembled with the armature inserted thereinto.

8. The segmented armature motor according to claim **6**, wherein the motor frame has a shape corresponding to the armature so as to allow the armature to be inserted thereinto, and includes coil recesses, first protrusions, and second protrusions formed therein.

9. The segmented armature motor according to claim **6**, wherein the motor frame is formed by laminating a plurality of iron core sheets.

10. A segmented armature motor comprising: an armature having a plurality of frame supports formed protruding inward directions and a frame fixtures formed protruding outward directions at intervals: a coil frame having a plurality of paired-coil frame support walls and coil frame partitions formed at intervals, the coil frame partitions being formed between inside of each paired-coil frame support walls, and the coil frame partitions being gradually widened

in a radial outward direction based on the paired-coil frame support walls, each which are slantingly formed in a radial outward direction based on the coil frame, the coil frame comprising a first coil frame and a second coil frame, each of the first and second coil frame being formed as symmetrical hemisphere a rotor inserted into the coil frame and having a rotary shaft; a paired dielectric sheet is mounted between the first and second coil frame; and a plurality of armature coils formed at each of the coil frame partitions of the coil frame, wherein each armature coil is formed in a hollow shape, is bent at each of the coil frame partitions of the coil frame, and is formed in a horseshoe or U shape, wherein each of the coil frame partitions has support slots at intervals and each of the paired-coil frame support walls is slantingly formed on both sides of in a radial outward direction based on the coil frame, each of the plurality of paired-coil frame support walls is inserted between the plurality of frame supports, each of the plurality of armature coils is installed so as to enclose an outer circumference and opposite sides of the rotor in three directions, where regions of N and S poles are divided into three equal parts, and wherein each of the plurality of armature coil is formed as gradually widened in a radial outward direction on each of the coil frame partitions side of the coil frame.

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